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U. S. DEPARTMENT OF AGRICULTURE.
BUREAU OF PLANT INDUSTRY—BULLETIN NO. 140.
B. T. GALLOWAY, *Chief of Bureau.*

THE "SPINELESS" PRICKLY PEARS.

BY
DAVID GRIFFITHS,
ASSISTANT AGRICULTURIST, OFFICE OF FARM MANAGEMENT.

ISSUED JANUARY 30, 1909.

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B. T. GALLOWAY, *Chief of Bureau.*

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BY

DAVID GRIFFITHS,
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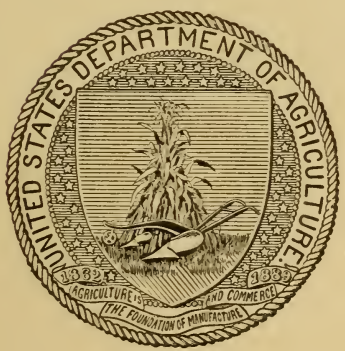
ISSUED JANUARY 30, 1909.



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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., November 4, 1908.

Sir: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 140 of the series of this Bureau, the accompanying manuscript, entitled "The 'Spineless' Prickly Pears." The paper was submitted by Prof. W. J. Spillman, in charge of the Office of Farm Management, with a view to publication.

This is a preliminary treatment of the subject, which it is desirable to have published at the present time for the information of the many farmers and ranchers in the arid and warmer sections of this country who are vitally interested in forage crops. Some limitations are placed upon the growing of the plants as farm crops which ought to be of service to those who may be misled by ill-advised stories of the phenomenal adaptability of this class of prickly pears in the agriculture of our arid States.

It is not the intention of Doctor Griffiths to discourage activity in the spineless prickly pear industry, for the plants have a use in some sections, and under proper conditions they can be profitably grown as a farm crop. He has simply prescribed some boundaries to their adaptability.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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B. P. I.—428.

THE "SPINELESS" PRICKLY PEARS.

INTRODUCTION.

The nearly thornless forms of certain members of the botanical genus Opuntia are known in various sections of the country under different names. Spineless prickly pear, spineless pear, spineless cactus, nopal, and Indian fig[a] all refer to the same group of plants. This paper deals with those forms of "spineless" prickly pears which are large in stature, comparatively rapid of growth, and of economic importance. They are large, nearly smooth plants which, with no preliminary preparation, cattle can eat without causing them serious inconvenience.

There are many species of prickly pear which are technically spineless, but being either small or having many small spicules they are of practically no economic importance. While these are, strictly speaking, spineless prickly pears, they are excluded from consideration in this paper, for "spineless" is used here in the popular economic sense.

This paper deals with all of the species, varieties, and forms of "spineless" prickly pears from whatever source they may be obtained. The facts laid down here are intended to apply to all of them. No species, varieties, forms, or hybrids of either modern or ancient origin are excepted.

ORIGIN OF "SPINELESS" PRICKLY PEARS.

The origin of "spineless" prickly pears is shrouded in as much obscurity as that of our common cultivated wheat, barley, apples, or any other crop long cultivated by man. It is supposed that there are no prickly pears, either spiny or spineless, which are native to any region of the globe outside of the American continents and their islands. While there are some circumstances which throw doubt upon this opinion, it is quite certain that spineless forms of the plants came originally from America and that they were consequently not known to civilized nations previous to the discovery of the Western Hemisphere. Precisely how they originated nobody can tell with

[a] The name *tuna* is also used, this being the Spanish word for the fruit of these plants.

certainty. It is reasonable to suppose and logical to think that they are the result of both conscious and unconscious selection continued through many generations of time, quite likely since long before the voyage of Columbus.

Mexico must be considered the most important prickly pear country of the world. Its population has obtained a portion of its sustenance from this crop since the earliest tribal times. The prickly pear emblazoned so prominently upon the coat of arms of the modern republic has its origin in legendary history. It is not at all far fetched to suppose that the Mexicans, although then ignorant of the laws of plant breeding, as they are even to-day, made slight improvements in the plants with regard to the spineless characteristics, for although they value some spiny species much more than they do any of the spineless ones they appreciate and take a pride in the spineless forms.

It has been a comparatively simple matter for the Mexicans to hold all the advantage they have gained from time to time by their selections, for the propagation has always been vegetative. Indeed, the plants are never grown from seed in Mexico, and it is commonly supposed among the poorer people, who are the ones that grow them, that they will not reproduce from seed. Many times has the writer been ridiculed for collecting seed of these plants upon the market places, and as many times assured that they would not grow. On one or two occasions cuttings have been brought to him the next day out of sympathy for his ignorance and an earnest desire that his efforts should not prove fruitless.

These circumstances show that vegetative propagation is practiced and that such propagation has a tendency to eliminate spininess where smooth forms are appreciated by even an ignorant peasantry. This, coupled with the fact that all species of the genus are very variable in spine characters and that nearly spineless forms of possibly one-half of the species of the flat-jointed group may be found to-day in nature, would appear to account for the origin of many spineless cultivated varieties. Others are doubtless species which have become nearly or quite extinct except in cultivation.

It has been assumed by some that the improvements of spineless forms were made in the Mediterranean region of Europe. This assumption is possibly based upon the fact that the plants are more numerous there now than elsewhere in the world. It seems rather doubtful to the writer, however, whether this assumption expresses more than a partial truth, for there is an abundance of forms to-day scattered all over Mexico which are just as spineless as any that grow and apparently are identical with the Mediterranean forms. It is quite possible that the spineless forms were taken to Europe from Mexico and South America in much the same condition as they are

FIG. 1.—A "SPINELESS" PRICKLY PEAR OF A KIND COMMONLY GROWN IN ARIZONA AND CALIFORNIA.

One-third to one-half of the fruits have been picked off.

FIG. 2.—A YOUNG PLANT OF A YELLOW-FRUITED "SPINELESS" AND SEEDLESS SPECIES OF PRICKLY PEAR FROM THE ISLAND OF MALTA.

grown there to-day. Our importations of spineless forms from Mexico and southern Europe have as yet not been grown together long enough or studied thoroughly enough, nor have our investigations in Mexico been sufficient to warrant an opinion as to the identity of the forms. Certain it is that there are some Mexican varieties which seem thus far to be identical with those of southern Europe. Others appear different.

Four spineless varieties are common in this country and have been cultivated for so long a time that their origin is not known. Some of these are as spineless as any known to science to-day.

AREAS WHERE "SPINELESS" PRICKLY PEARS ARE FOUND.

In the United States there exists to-day a considerable stock of spineless forms of prickly pears. Possibly not less than a half dozen species and varieties are more or less common in gardens and private collections of the warmer sections, notably in California, in extreme southern Arizona (see Pl. I, fig. 1), on the coast of Texas, and in Florida. There is nowhere any large number of specimens, only a few plants usually being cared for.

The varieties commonly found in this country are few in number compared with those of other warm regions. During the past five years not less than twenty-five varieties have been imported by the Bureau of Plant Industry. They have come from Mexico; the Mediterranean region of Europe, Asia, and Africa; the Hawaiian Islands; and from some South American countries. There are forms grown commonly in South Africa and in Australia and some of the other Pacific islands. It is believed that there are not less than thirty species and varieties belonging to the two genera Opuntia and Nopalea which have an agricultural value. The small, technically spineless but spiculed forms of no economic value are not considered in this list. Only those which are rapid in growth and become large plants are considered here.

CHARACTERISTICS OF A GOOD "SPINELESS" PRICKLY PEAR.

A good prickly pear of any kind must be first of all a rapid grower. This is the all-important consideration within the zone in which the plant is hardy. The chemical composition of the plant may be left entirely out of consideration, for the rapid-growing spineless forms do not differ enough in composition to make it worth while to consider that feature.

The feature next in importance to rapidity of growth is good habit of growth. There is much more in this subject than one would be inclined to believe at first, and the writer's limited experience does not warrant a full discussion at this time. It must be remembered that

the raising of spineless prickly pears is in no sense a range proposition. The plants can not be put out to shift for themselves; they must be farmed like any other crop. Above all, in order to produce they must be cultivated, and to be cultivated they must have a habit of growth that will permit it. There are some varieties of quite rapid growth which have a reclining habit. This would make it very difficult to get around them without having the tools break them down badly, necessitating a great deal of hand work in keeping down weeds. The writer is not ready at present to discuss the different varieties in respect to habit, for no one in this country has yet grown any of the forms under field conditions. While the plants need to be erect to facilitate cultivation, it must be remembered that they are very brittle and consequently must not be of the spindling kind not strong enough to support themselves or withstand the force of winds of the region in which they are grown. In short, the variety best suited to cultivation is rapid in growth and erect and stocky in habit.

PERMANENCY OF THE SPINELESS CHARACTER.

Since all spineless prickly pears are more or less spiny it is naturally to be expected that under certain conditions they will become more so. What all the conditions which affect the development of spines may be the writer is not now prepared to discuss in detail, and the suggestions given here are only tentative and reservedly stated.

It has been shown in another publication[a] that the spiny prickly pears which are natives of Texas become even more spiny under cultivation in the same locality. So far as investigations thus far conducted are concerned, good conditions do not increase the numbers or size of the spines of the spineless species. Upon the immediate coast of California, under the influence of sea breezes, the forms of *Opuntia ficus-indica* do not develop into such smooth plants as they do farther inland, where the temperatures are higher, the winds less severe, the sea breezes cut off, and the plants less dwarfed. The spines do not appear to increase so much as the spicules.

The conditions to the northwest of the Salton Sea are also favorable to the development of spicules upon this species. The forms become considerably more difficult to handle when grown there. The same appears to be true in the Salt River Valley. *Opuntia monacantha*, another introduced species, while much dwarfed wherever grown in this country, does not seem to increase its spines or spicules under the above conditions. It is, however, a spiny species.

In short, it seems from investigations thus far conducted that hard, unfavorable conditions, such as proximity to the sea, alkalinity,

[a] Bulletin No. 124, of the Bureau of Plant Industry, entitled "The Prickly Pear as a Farm Crop."

extreme heat, extreme drought, and possibly low temperatures, contribute to increase the spines of these nearly smooth opuntias. But while this is true, observations thus far made do not indicate that there is any probability that the spines or spicules will increase until these prickly pears will require singeing before cattle can eat them. The increase is not at all alarming, even after four or five years' growth in unfavorable situations. While there appears to be an increase, it is believed that this feature can be left out of consideration from an economic point of view. While there may be a slight increase of spicules, especially under unfavorable circumstances, it will not be enough to make any practical difference, although of a great deal of scientific interest.

TREATMENT OF CUTTINGS.

There appears to be among certain horticulturists and others an opinion that prickly pears must be abused in order that their growth may be insured. Nothing can be farther from the truth. These plants thrive best when most carefully managed. The practice of wilting the joints in greenhouse culture has arisen from the fact that the average greenhouse is a very artificial and inappropriate place to grow cacti of any description. The ground is commonly more wet than that to which the plants are accustomed and the atmosphere contains altogether more moisture than most situations where plants of this class grow. Even here no wilting of the cuttings is necessary. It is essential, however, under moist conditions to have the cut surface well dried before placing it in moist earth; otherwise it will start to decay and communicate decay to adjacent healthy tissue instead of healing over and callousing, as in other woody plants. The prickly pear cutting does not form a callus upon the cut surface and root from the callus like the common fruits; it simply heals over. Roots grow from areoles, or cushions, from which the spines and spicules develop.

It is no more necessary to wilt cuttings of prickly pears than it is to wilt cuttings of the grape, or willow, or privet before planting them. The only difference is that the prickly pear, on account of the large amount of moisture in its tissues, can withstand such treatment, while the other plants can not. Being able to endure it the treatment insures the drying of the cut surface, which is imperative under moist or wet conditions.

The fact that cacti are able to withstand certain abuses is no proof that such conditions are best suited to their growth. That the plants are sometimes able to exist on the top of adobe buildings or even on a board roof is not proof of their adaptability for growth as forage upon deserts, nor is it evidence that they should receive abusive treat-

ment in order to develop properly. Plants in our possession have lived for two years while hanging upon a barbed-wire fence, and they made some new growth, too, but it was at the expense of the old. These instances are simply interesting and should not be accepted as proof that hard treatment is necessary in order to have the plants make their best development.

The writer's experience is sufficient proof that under open-air conditions in our arid and semiarid States no wilting of the joints is necessary. In the spring of 1908 about 3,000 cuttings were planted upon the propagating grounds at Chico, Cal. In no case did more than an hour elapse between the removal of the stock from the parent plant and its insertion into the ground in permanent position. It is quite probable that at least half of the cuttings were actually planted in less than twenty minutes after they were cut. The writer prepared the cuttings with a spade. Two or three men were employed to distribute them, and another man followed with a team and plow and covered them. Less than 1 per cent of the cuttings died from all causes. There is no evidence that any were lost from rot due to the failure to wilt them. The ground was rather dry, however, but not so dry but that the cuttings made a good growth and were in a thriving, healthy condition when the writer saw them the following August. There were, in all, about 30 varieties, both spineless and spiny, the former predominating.

The same spring a large planting was made at San Antonio, Tex., also. In this case about 600 cuttings, representing one-half as many varieties, were planted in very wet soil. Indeed, planting was delayed several days in order that the ground could be worked. A rain followed close upon the planting, and rains occurred at frequent intervals during the entire summer. It was really the wettest season in many years, the ground being in such condition during the early part of the summer that proper cultivation could not be practiced. Still, less than 2 per cent of the cuttings died from all causes. A few rotted at the surface of the ground and the plants fell over in midsummer, but this was due in every case, as investigation subsequently proved, to the ravages of white grubs.

In the spring of 1906, which was a normal season, 6 acres of spiny natives were planted at San Antonio, Tex. The cuttings were set 2 feet apart in 6-foot rows. This gave, in round numbers, 4,500 cuttings to the acre. One half of the cuttings was planted by being plowed in; the other half was simply placed in position on the surface of the ground in firm contact with the soil. In this case stock was secured from a neighboring field, large plants being cut down, loaded into wagons, and distributed upon the field. These were subsequently chopped up into single joints with a spade, distributed in a furrow, and then covered with a plow following close behind. In

some cases twenty-four hours elapsed between the preparation of the cuttings and their setting in the ground; in other cases only a few minutes. A practically perfect stand was secured over the entire field.

Certainly no further evidence is necessary to convince anyone that the wilting of the cuttings is, at least, superfluous.

If the cuttings are allowed to lie on a surface of damp ground for a week or ten days, they will start a root system in the spots (areoles) in contact with the earth and absorb water to make up for that lost by evaporation. If the ground be dry they will suffer, and in very hot regions they will often be killed in a short while when they have no chance to make up for the loss of evaporation from such severe exposure.

In short, cuttings of prickly pears do not need wilting before being planted. They will wilt enough in the ground under ordinary conditions before they can strike root. Whatever water is lost by evaporation must be made up again by absorption before the plant will make its best growth. The wilting simply weakens the plant.

PLANTING.

The planting of prickly pears does not differ materially from that of any other crop except that one has, owing to their resistance, more latitude with these cuttings than with those of almost any other crop. However, it must be remembered that the grower will be charged up with any abuse which the plants receive.

Under any ordinary conditions the cuttings should be planted as soon as prepared. When they have been shipped from a distance no time should be lost in getting them into the ground. If they have been bruised in handling and show blackened decayed spots, these should be cut out with a sharp knife and the cut surface, if it is to go into the ground, allowed to dry thoroughly—in the shade if the sun is very hot. If the cut surface will be above ground when the cutting is planted or if the ground is dry, obviously no drying is necessary and the cutting should be set immediately.

The cuttings will ordinarily consist of single joints of stem cut close to the articulation or constriction between them. These should be buried in the ground to one-half their length unless the cutting be very small, when more than this proportion should be buried. When few cuttings are to be planted they can be set upright by hand, but much labor can be saved in large plantings by opening up a furrow with a plow. The cuttings are then distributed at proper distances and leaned against one side of this shallow ditch. Another furrow is then turned over on the cuttings in position. Care should be exercised not to completely cover any of them, for they do not

appear to have any power of pushing up new growth through the soil. Subsequent cultivation will level off the ground.

Lack of experience in growing the spineless prickly pears in this country renders it difficult to say at exactly what distances they should be planted. Judging from our experiences with spiny forms it is thought that 3 feet apart in 6-foot rows is the most advantageous distance when the plants are to be grown for forage and harvested every two or three years. If it is intended to grow the plants to maturity, 8 by 8 feet is none too much room; it is possible that 10 by 10 feet would be better.

CULTIVATION.

The ground should be deeply and thoroughly prepared. Subsequent cultivation should be frequent enough to prevent the soil from baking, to preserve the moisture, and to keep down weeds.

So far as known, no one in this country has had experience in the use of fertilizer on these plants.

HARVESTING.

It is quite probable that it will prove to be best to harvest spineless as well as spiny prickly pears biennially. It may be that in certain favored localities enough growth will occur for harvesting each year, but the feed will be a little better if allowed to stand upon the plants the second year, as it will then contain more substance and be less watery. It has been our experience that a growth of the spiny Texas pear of even 23 tons to the acre is not enough to be harvested advantageously. There are few sections where it is thought the growth of any of the spineless species without irrigation will be in excess of this.

When harvesting is done the plants are cut down, preferably with an instrument resembling a spade. A hoe straightened out so that the blade is in line with the handle is very suitable. A quick chop with such an instrument will sever most stems.

The harvesting should not be too close. Enough of the old stump should be left to preserve a good surface for the production of new growth. The cut surface should be left as clean-cut as possible. Quick, vigorous action with the instrument, insuring the felling of the plant or branch at one stroke, will produce the best results. In no case should a ragged surface be left upon the stump; it will usually be better to make a new cut lower down, trimming off the ragged edges. Where possible, the cut should be made just above rather than just below the articulation between the joints.

The crop will always be harvested as needed. It is not adapted to being stored, cured, or housed, but may be harvested at any season of

the year. Experience with spiny forms indicates that the stump is more likely to decay when harvesting is done in cold, moist weather. However, this is a point to be worked out. More data are needed upon it.

When cut down the plants can be loaded on wagons with forks and hauled to the feed lot. Too much waste will attend the turning of cattle into the field.

RESISTANCE TO COLD.

The accompanying map (fig. 1) shows in a graphic way where spineless cacti, according to our best judgment, are adapted to grow. The Bureau of Plant Industry has as yet grown plants in but little of the territory thus outlined, but the writer has had a large ex-

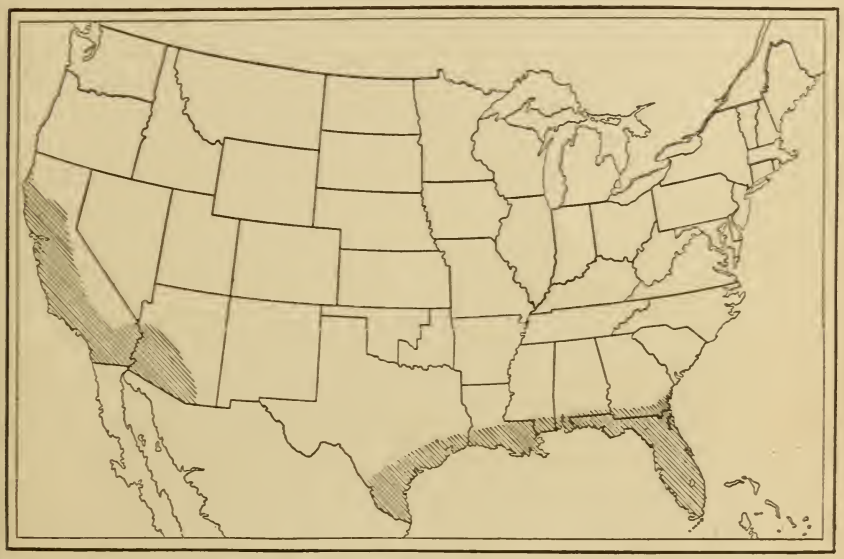

FIG. 1.—Map of the United States, showing the areas (shaded) where "spineless" prickly pears may be grown. The minimum winter temperatures will prevent their growth outside of the shaded areas.

perience through the entire region and believes that he has been liberal in allotting territory to this crop.

It must be remembered that throughout this region live many Mexican families. They take with them the prized nopal, both spineless and spiny, wherever they go. They may not cultivate it, for they have not been used to doing that, but they will put cuttings in the ground and throw a little water on them occasionally. Were it possible to secure records of all the work which these poor people have done in this line it would be feasible to-day to mark absolutely the limit of possible spineless pear culture in the United States, west of Louisiana at least. But such records are impossible to secure satis-

factorily, although the writer has been greatly aided by the suggestions and information furnished by these people. It will be necessary to try to perform in many places what they have already tried to do in a small way and failed. However, their work is in evidence in many places and affords a good basis for information.

A single illustration of the value of these Mexican importations will suffice. At Phoenix, Ariz., there are commonly grown in dooryards plants of *Opuntia ficus-indica*, probably introduced by Mexicans, but this is not material. They are there and their habits are known to observant people. Dr. R. E. Kunze finds that his plants freeze and drop off every winter after they get more than about 9 feet high, when they lose the protection of surrounding shrubbery. All horizontal branches which are therefore poorly supported are almost sure to break off during the winter on account of the cold. It is certain that the injury under field conditions would be greater than this. This is proof conclusive that the conditions at Phoenix are about the limit of the endurance of the plants.

The spiny mission pear is also found at Phoenix, Ariz., and it behaves like the spineless *Opuntia ficus-indica*. It is as hardy as any of the spineless forms, and more hardy than most of them. The probability is that the spineless form now growing there is only one of many that have been planted and that it survives simply because it is more hardy than the others; but even this form is not perfectly adapted to this locality.

The experience of the Bureau of Plant Industry at San Antonio, Tex., has been stated in other publications. Out of about twenty-five species and varieties of "spineless" prickly pears planted there, none will thrive without winter protection.

PRICKLY PEARS IN A COLD REGION.

Under the previous heading is discussed the area adapted to the culture of the crop. There is no doubt that spineless plants may be bred to withstand a greater degree of cold than any that now exist, but there is a limit to profitable efforts in this direction.

Suppose, for instance, that it were possible to produce twenty tons of spineless cactus to the acre in western South Dakota. It could be fed to stock only during the warm portion of the year. It would be of practically no value during the long cold winters when most needed. It would be frozen like an icicle at any temperature below 18° F. Cattle, according to our experience, will eat frozen pear, but they do not thrive on it.

MOISTURE REQUIREMENTS OF PRICKLY PEARS.

The growing of "spineless" prickly pears in this country as a field crop is as yet only an experiment. There is no instance where any of

the varieties have been grown even to the extent of an acre, except possibly in the case of the vague and imperfectly recorded operations of Turnbull in Florida. It is not surprising, therefore, that it is impossible at the present time to say just what are the moisture requirements of "spineless" prickly pears. We know, however, certain limits and are able to map out certain crude boundaries.

The writer believes that the plants will grow under cultivation without irrigation on the Gulf coast of Texas and in California from the Sacramento Valley south. Under the influence of the ocean they may get along with neither cultivation nor irrigation, but in the interior valleys they will have to be carefully cultivated in order to conserve the moisture after the rains cease in the spring. Experience has proved this at Chico, Cal.

In the great arid interior region extending eastward from the southern Sierras, the prickly pears will have to be irrigated before they will make any growth worth while.

The statement which the writer made in a previous publication applies with equal force here and will bear repetition. The prickly-pear plants are adapted to a region having a considerable rainfall too irregularly distributed for ordinary crops. They must have water to grow and considerable of it. They are the camels of the vegetable world. They must have water, but they can get along for long periods without it.

INVESTIGATIONS NECESSARY.

The reader who has followed these pages thus far will readily recognize that what is needed in the "spineless" prickly pears to-day is greater hardiness. This quality can not be bred into them in two or three years. There are spiny species which will live under temperatures of 40° F. below zero, but these are of no value as forage. It will be necessary to combine the characteristics of the spineless varieties of to-day with the hardy characters of some of those very spiny hardier forms in order to make them of value in the colder arid regions.

It might be possible by careful breeding and selection in a decade or more to increase the hardiness of the rapid-growing prickly pears so as to withstand a temperature of somewhere about zero instead of 20° or 25° F., which are the limiting temperatures now. There are large spiny species which are hardy at this temperature and will form a much better basis for improvement than the small runty forms of the North. This will push the limit of their cultivation to the northward very materially. Even this will take much patient toil and labor and many years of experimentation.

There are two ways of attacking the problem. One may depend upon selection alone. To gain hardiness by this method one would

be obliged to discard the present spineless species entirely and work with the hardy spiny natives, for it can not be expected that the spineless forms can be so improved within themselves as to withstand 25 degrees more of cold than they do now. It would be a problem, indeed, to eliminate spines and spicules and at the same time bring the stature and rapidity of growth of even such a plant as *Opuntia lindheimeri* up to that of the present spineless forms.

The other way is to hybridize the present spineless forms with some hardy plant possessing as many desirable characters as possible. It will usually be necessary to grow this hybrid to maturity, plant its seeds, and then begin a long series of selections from these so-called second generation hybrids. But it will take a season to produce the hybrid, five years more to bring this hybrid to maturity, and two or three years more to bring the seedlings of the second generation to a stage sufficiently advanced to justify selection. One is then ready, provided no accidents have happened and the species which he has selected will hybridize, to begin selection. It will be necessary to decide whether selections can be made most advantageously from vegetable (cuttings) or sexual (seed) propagation. The slight variation that occurs in vegetative propagation renders this method of improvement practically useless. The method of improvement by seed selection requires several generations of plants.

When it is remembered that cacti can be grown from seed only with difficulty and that several years are required to grow a generation to the stage of seed production, the magnitude of the task of improving cacti is easily seen. Of course one can only guess at the number of generations necessary to select from in order to produce a spineless, rapid-growing, hardy progeny from two such parents as we have assumed. We are safe in presuming that it would take several. It must be remembered that neither of the parents is really spineless, even the so-called " spineless " one having some spines and a strong tendency to revert to a more spiny condition. If we could be satisfied with a spiny plant, the problem would be very much simplified. It takes a long time to breed the spines off entirely, or even practically, but to produce a hardy rapid-growing plant should not be so difficult provided one's conception of hardiness is not too exacting. The prediction is ventured that if any improvement is made in the hardiness of rapid-growing varieties it will be through the spiny plants and not the spineless ones.

The main work which the Bureau of Plant Industry will undertake with spineless species during the next two or three years is to test varieties which are now being propagated. Vastly more knowledge is necessary regarding these before anyone will be in a position to inaugurate breeding operations.

THE PRICKLY PEAR A FARM, NOT A RANGE, CROP.

In no sense is the growing of "spineless" prickly pears a range proposition. The plants will no more thrive upon the open range when planted and allowed to shift for themselves than sorghum, sugar cane, or corn in any portion of the United States of America. They will have to be carefully husbanded like any other crop. All rodents are fond of them, and where abundant enough, as they are in the majority of range sections, these alone would exterminate the plants. Even in fenced pastures, where practically no rodents might occur, the live stock would exterminate the plants, as the writer has shown in previous publications.

There is no use whatever in considering the growing of this crop from any other standpoint than in a fenced and cultivated field from which all animals are excluded, unless the area be large enough to supply more feed than the rabbits, mice, rats, and gophers can eat up. The prickly pear is purely a crop to be farmed. It is a mistake to expect the crop to take care of itself when once planted.

"SPINELESS" PRICKLY PEARS COMPARED WITH OTHER FEEDS.

No direct tests have been made to show the relative value of "spineless" prickly pears and other kinds of roughage. In another publication[a] the writer showed that 6 tons of green, succulent, spiny prickly pears when singed were equal as a roughage to 1 ton of sorghum hay. The chemical composition of the spiny prickly pears (*Opuntia lindheimeri*) used in the experiments from which this comparison was drawn is not sufficiently different from that of the spineless forms to warrant a change in the above ratio when an estimate is made of the value of the spineless forms.

It should be understood that prickly pear is only a roughage at best and should never be considered as anything else. Quite a number of chemical analyses of spineless forms have been published, but the data are always incomplete. In only one or two cases are we told what portion of the plant was analyzed. There is often more difference in composition between portions of the same plant varying two or three years in age than there is between different species. The fact that some of these analyses show up extraordinarily large in water is therefore misleading. It is the judgment of the writer that the difference between the actual results obtained in feeding the spiny and the spineless forms of prickly pears will be very slight indeed. It should be remembered that prickly pear is a roughage; it is high in water content, low in nutritive value, very palatable to stock, and must be fed in large quantities, 90 to 150 pounds a day, to produce good results.

[a] Bul. 91, Bureau of Animal Industry, U. S. Dept. Agriculture.

HOW FARMERS CAN SECURE PRICKLY PEARS FROM THE DEPARTMENT OF AGRICULTURE.

There are a number of nurserymen who have now on hand stock of some varieties of prickly pears and are offering the plants for sale, usually under the name of "spineless cactus." Farmers who desire to grow this crop should consult the map on page 15. If located outside of the area shown, no one will be justified in spending either time or money in the expectation of making an economic crop out of "spineless" prickly pears. Outside the shaded area on the map, attention should be given to spiny, hardy varieties.

The Department of Agriculture will have for distribution in the spring of 1909 about 7,000 to 9,000 cuttings of "spineless" prickly pears. Some of these will be used in special experimental work by the Department, and the remainder will be furnished to those who apply for the cuttings previous to the middle of February, 1909.

Applications will be filed in the order of their receipt. Should there not be enough stock to fill all demands at that time, cuttings will be sent either the following August or February, depending upon the number of applications received and the amount of stock on hand.

No stock will be distributed outside of the territory marked as adapted to growing these plants on page 15, except it be a cutting or two which may be desired for a special purpose and which will receive winter protection.

Applications for cuttings should be made to the Office of Farm Management, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

NATURE AND ORIGIN OF THE PRICKLY PEARS TO BE DISTRIBUTED.

At various times during the past ten or fifteen years the Office of Foreign Seed and Plant Introduction of this Department has imported small quantities of stock of "spineless" prickly pears from the Mediterranean region. This material has either been kept in a greenhouse in Washington or distributed gratis to various individuals throughout the country, with little if any attention being paid to it afterwards until the past few years. This promiscuous distribution forms the basis of the greater part of the spineless stock in this country now.

Since 1904 a systematic effort has been made to secure all the information available about the plants. Personal explorations have been made, mainly in Mexico and the United States. In other regions dependence has necessarily been placed on correspondents. From all sources, however, approximately 500 species and varieties of prickly pears have been introduced. About 25 of these are spineless, and 10

or 12 of them are sufficiently promising to warrant their being sent out to growers interested in them. Some are of Mediterranean origin (see Pl. I, fig. 2) and some of Mexican origin.

In no case was there any large amount of stock of any variety imported, usually only 3 to 6 cuttings. Having but meager information about the different varieties, it was thought better in many cases to divide even this small amount of material between two or more localities in order to insure having it preserved in one situation should it not succeed in another, and this precaution has proved to be a wise one. On this account it has taken four years to bring together sufficient stock to warrant distribution on any extended scale.

With such a large importation of material there is a great range of varieties to select from, from the spiniest to the least spiny of any that are known. The so-called "spineless" ones which will be distributed vary in the number of spines. Like all material known to science to-day none of them is entirely spineless, and there is none perfectly spineless anywhere. But in all of these the spines are so unimportant that they can be easily handled and stock can eat them without singeing. They have been neither bred nor selected. They have been subjected to no horticultural manipulations whatever in our hands. They are exactly as we found them, and similar plants may be secured by anyone in the same localities where these were obtained. All that the Department of Agriculture has done is to import the stock and propagate it.

Distributions will not be confined to the spineless species. So far as stock is available, others will also be sent out if there is call for them. There are many very spiny species which bear fruit as good or even better than the spineless ones. However, nearly all of the spineless varieties produce edible fruits.

It should be remembered in this connection that although the plant body of this group of prickly pears is spineless, the fruits of all of them have many of the small spicules, rendering them somewhat disagreeable to handle.[a] There are no prickly pears anywhere with smooth fruits. The nearest approach to this condition is in the genus Nopalea (the vast majority of the prickly pears belonging to the genus Opuntia), in which one species is found which is not only smooth in plant body, but has fruits which are also nearly smooth; but even here there are a few of the small spicules, and the fruit is of no value.

The following table contains a partial list of the species of prickly pears which will be ready for distribution in February. They will be distributed under the numbers in the first column. The names

[a] For directions regarding the handling of these fruits by the Mexicans, see Bulletin 116, Bureau of Plant Industry, entitled "The Tuna as Food for Man."

are almost invariably those under which the importations were received and consequently can not be vouched for in all cases. There are many others which may be distributed sparingly, but the stock of them is at present very limited.

TABLE I.—*Species and descriptions of prickly pears of which the Department of Agriculture will distribute cuttings in territory of the United States adapted to their growth.*

Number assigned to species.	Name of prickly pear.	Origin of plant.	Kind of fruit.	Condition as to spines.
14807 S. P. I.	Opuntia ficus-indica	Malta	White, large	Spineless.
8032 D. G.	Nopal amarillo	Mexico	Yellow, large	Spiny.
8094 D. G.	Opuntia fusicaulis	do	(?)	Spineless.
14819 S. P. I.	Opuntia ficus-indica	Sicily	(?)	Do.
14809 S. P. I.	do	Malta	Reddish yellow, seedless.	Do.
15839 S. P. I.	Españoles	Spain	Good	Do.
14820 S. P. I.	Bianchi / Opuntia ficus-indica	Sicily	(?)	Do.
14818 S. P. I.	do / Senza chiupi	do	(?)	Some spiny; others spineless.
15841 S. P. I.	Moscatel	Spain	(?)	(?)
1258 P. I. G.	(?)	California	(?)	Partially spiny.
1257 P. I. G.	(?)	do	(?)	Do.
1256 P. I. G.	(?)	do	(?)	Do.
8074 D. G.	Incarnadillo	Mexico	Large	Spiny.
14983 S. P. I.	Opuntia robusta	Tunis	Large, purplish red	Spineless.
14982 S. P. I.	Opuntia ficus-indica	do	(?)	Do.
15943 S. P. I.[a]	do	(?)	(?)	Do.
15842 S. P. I.	Tintillas	Spain	(?)	Spiny.
8043 D. G.	Nopal tapon liso	Mexico	Large, purple	Spineless.
8105 D. G.	Nopal colorado	do	Large, red, mottled.	Spiny.
8121 D. G.	Nopal arton	do	Medium in size, deep red.	Do.
14808 S. P. I.	Opuntia ficus-indica	Malta	Red	Spineless.
8126 D. G.	(?)	Mexico	Red, small	Spiny.
8140 D. G.	Nopal camueso	do	Red, large	Partially spiny.
8146 D. G.	Nopal blanco	do	White, large	Spiny.
15777 S. P. I.	Opuntia gymnocarpa	France	(?)	Do.
15843 S. P. I.	Franceses	Spain	(?)	Do.
8092 D. G.	Nopal tapon	Mexico	Red, large	Do.

[a] This number is probably wrong.

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